

Dream

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- Primary Question

- Do intensity levels produced during routine ensemble-based instructional activities exceed allowable limits set by the National Institutes of Occupational Safety and Health?

- Methodology

- Routine (daily) dosimeter measurements
 - Single point
 - Five rehearsal rooms
 - Inclusion criteria:
 - $L_{eq} \geq 85\text{dB(A)}$ for rehearsal period
 - Minimum of 5 samples per ensemble

Sample Dosimeter Output

General Information	
Serial Number	21230
Model	703+
User	
Job Description	27
Location	6
Start Time	Monday, 03 March 2008 16:00:00
Stop Time	Monday, 03 March 2008 16:50:00
Run Time	00:50:00
Pre Calibration	Thursday, 10 May 2007 09:56:00
Post Calibration	None
Calibration Deviation	---
Sample Interval	1 Sec.s

Note

Results

	Dose 1	
Dose:	134.7	%
Projected Dose:	1292.8	%
Leq:	96.1	dBA
TwA:	96.1	dBA
TwA (8)	86.3	dBA
Lmax:	104.3	dBA
Lpeak (max):	134.9	dB
Lmin:	51.5	dBA
Lep (8)	86.3	dBA
SE:	1.4	Pa ² hr
Overload?	No	

Settings

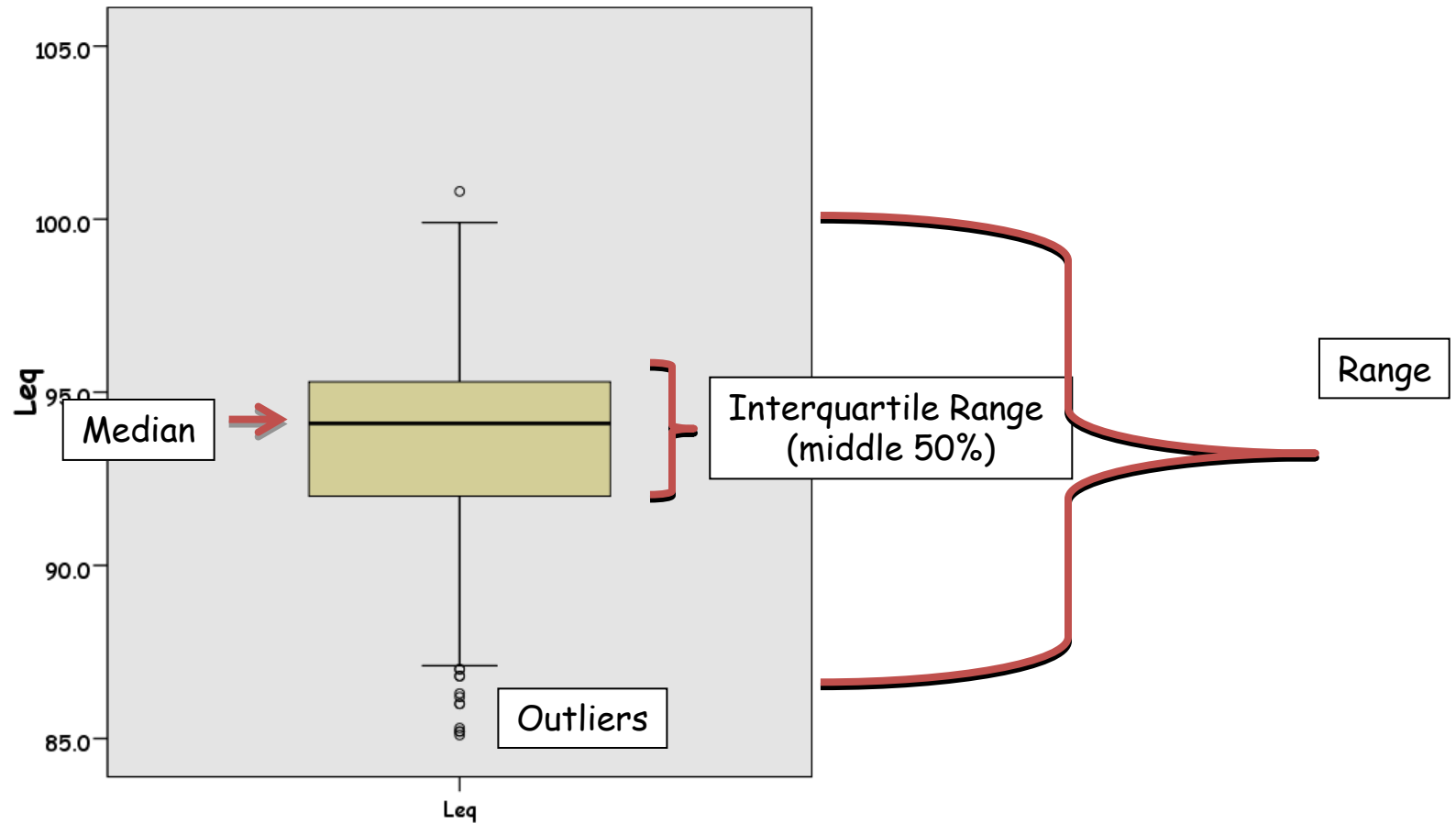
Exchange Rate:	3	
Threshold:	0	dBA
Criterion Level:	85	dBA
Criterion Duration:	8	hours
RMS Weight:	A Weighting	
Peak Weight:	Unweighted	
Detector:	Slow	
Gain:	0	dB



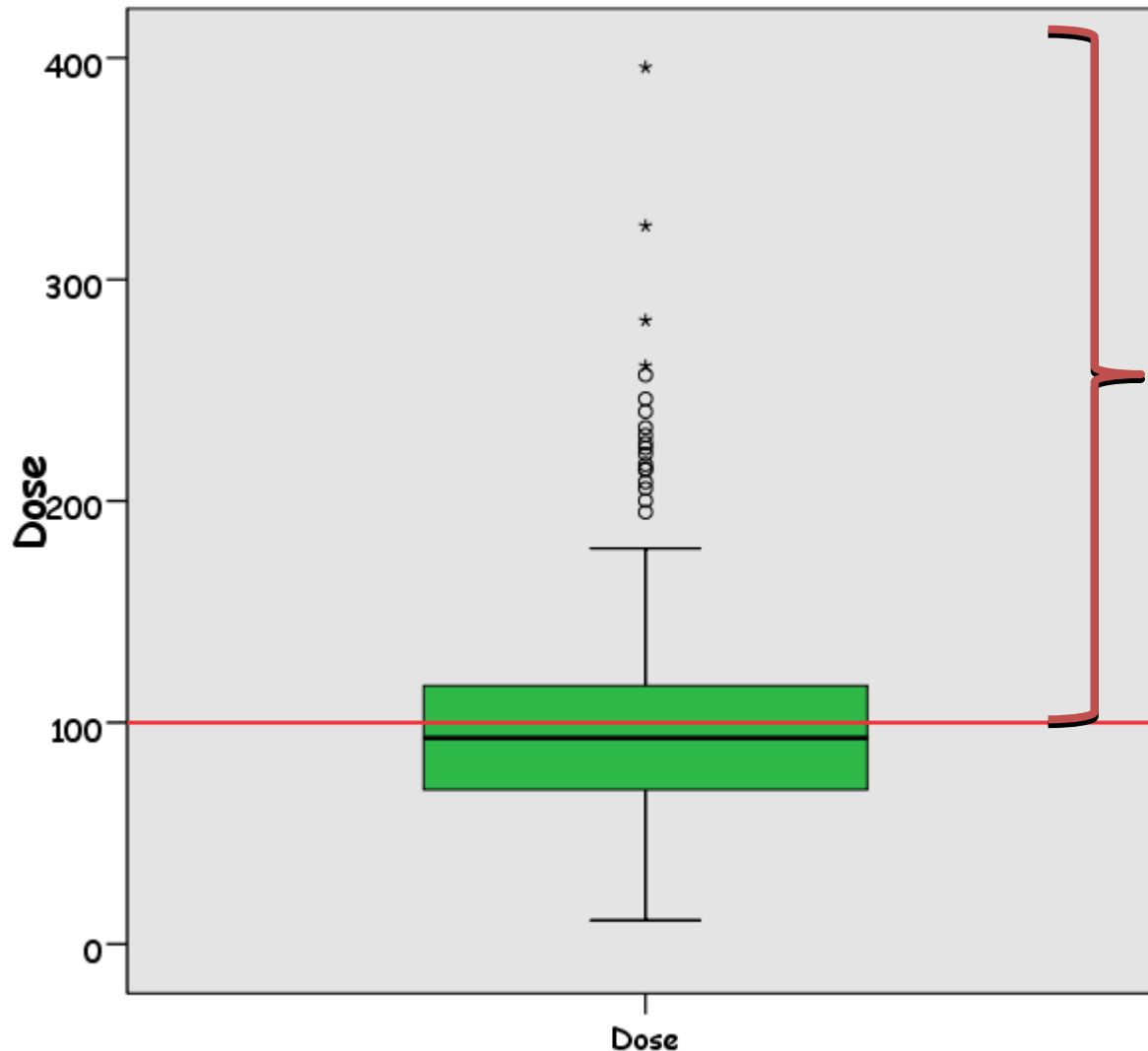
Dosimeter set according to NIOSH Publication No. 98-126
85dB Criterion Level and 3dB Exchange Rate

www.cdc.gov/niosh/docs/98-126

Leq Data (N=666 instructional activities)



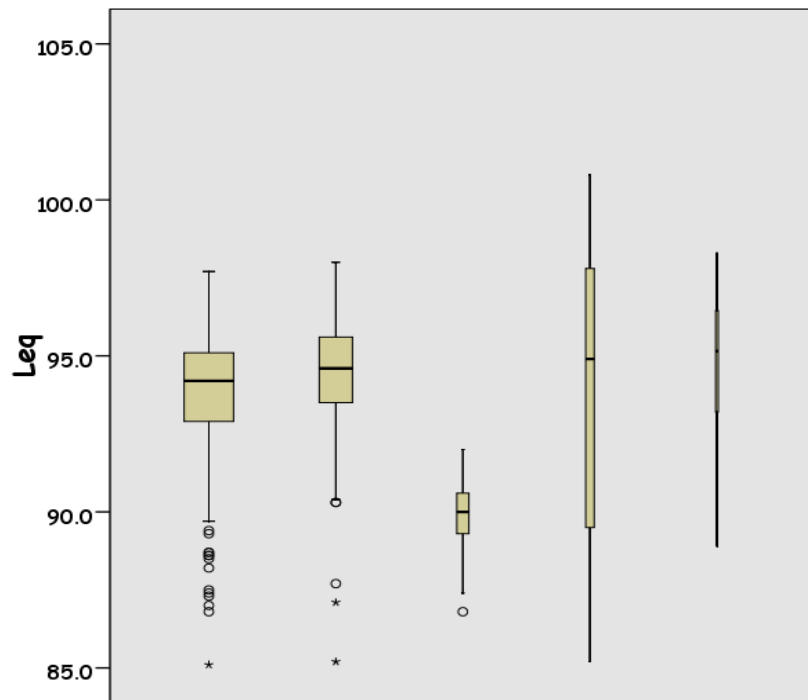
Dose Data (N = 666 instructional activities)



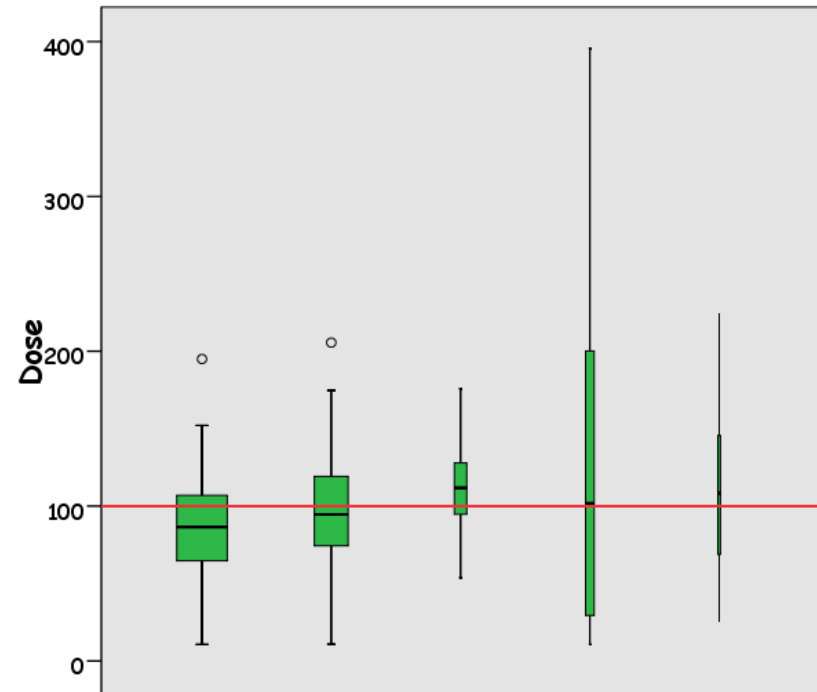
Results

Over forty percent of cases (N=282) exceeded maximum allowable exposure levels (100% Dose) for "entire" day.

Leq and Dose by Room



Kenton East IRR 262 142



Kenton East IRR 262 142



Kenton Hall (KH)
2418 ft²



Lab East (East)
1007 ft²



Instrumental Rehearsal
Room (IRR) 3000 ft²

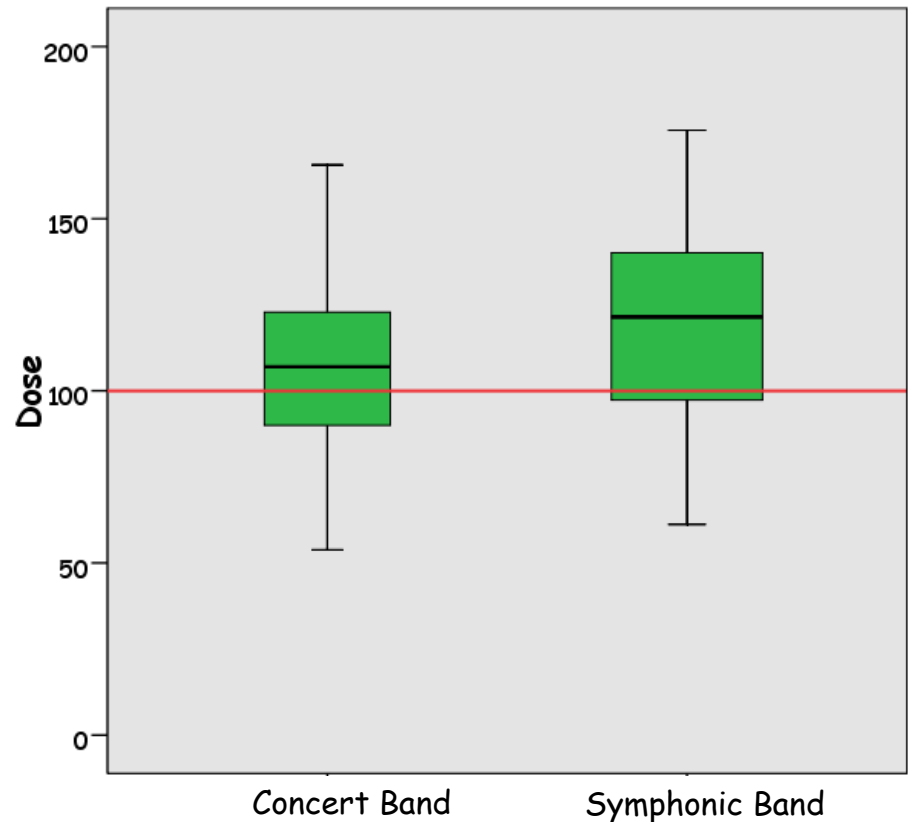
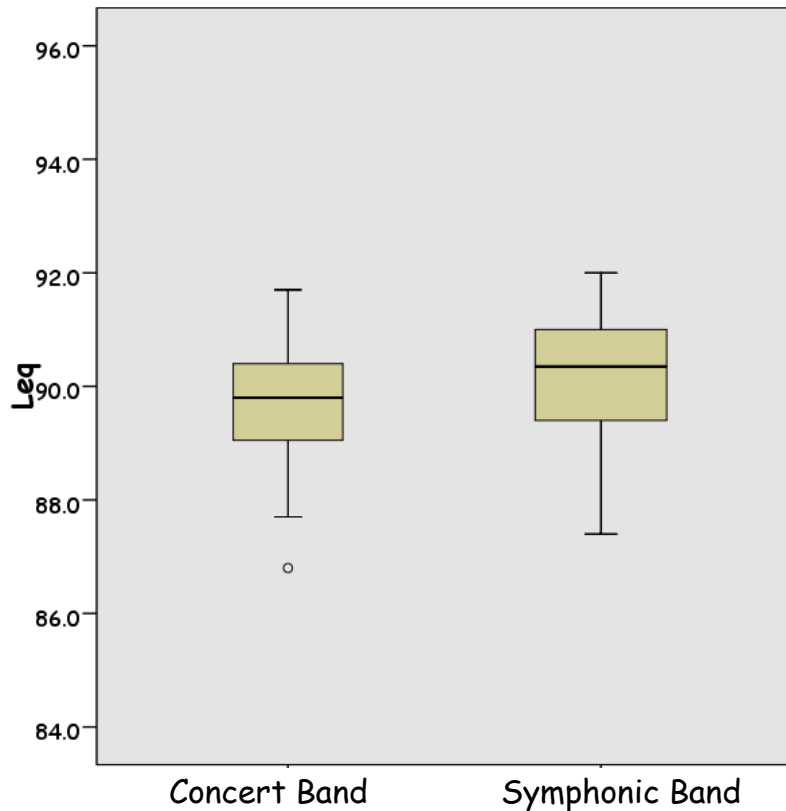


Room 262
1305 ft²



Room 142
1016 ft²

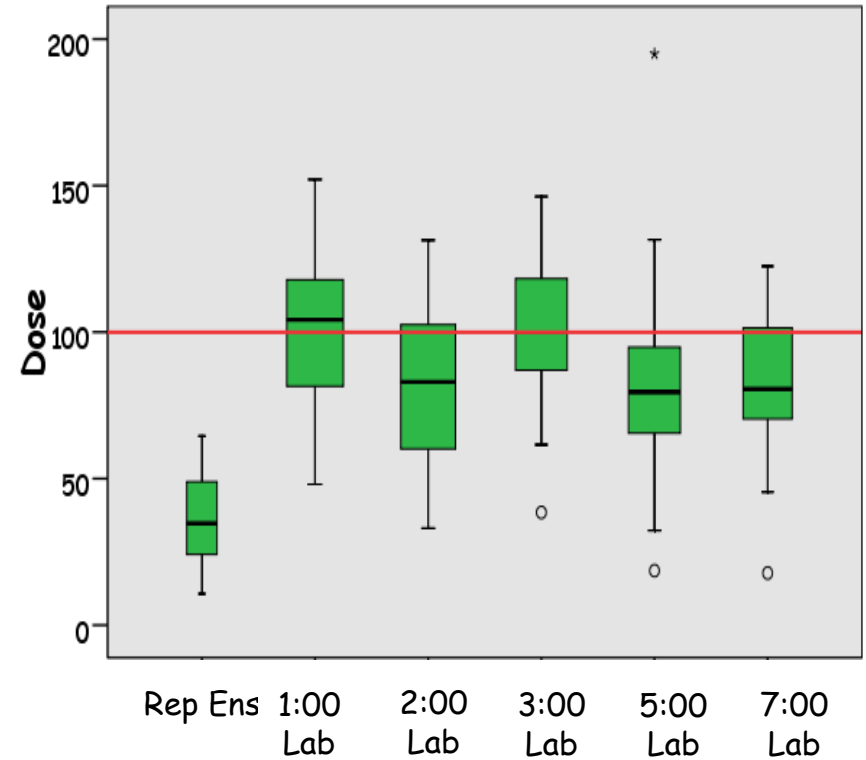
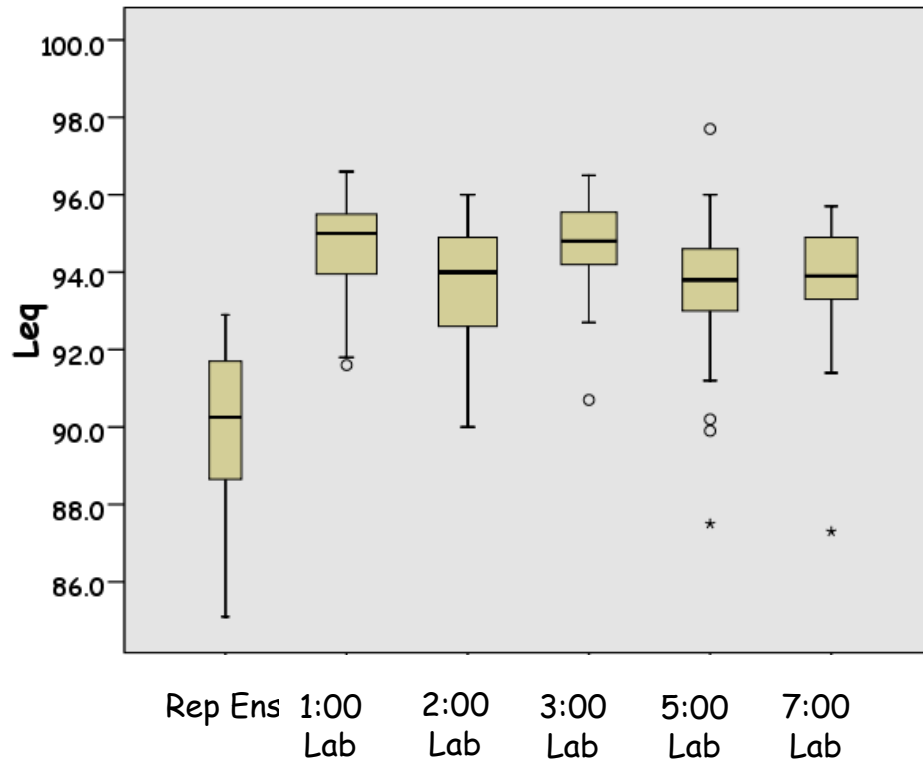
Ensembles in Instrumental Rehearsal Room



The two large wind bands represent a common ensemble type for most college programs. Both groups have traditional concert band balanced instrumentation with total membership of 70-80, depending on the pieces they are doing. The distribution is roughly as follows: Woodwinds - 50%, Brass - 45%, and Percussion - 5%.

Classes are scheduled for 3 hours.

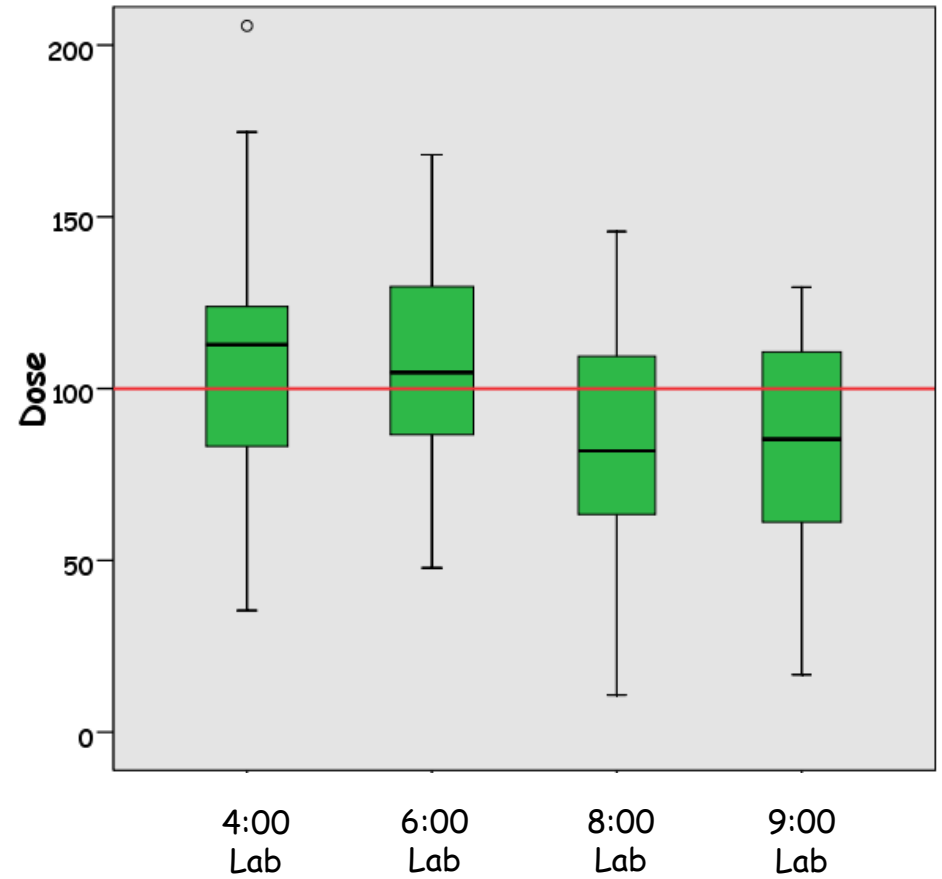
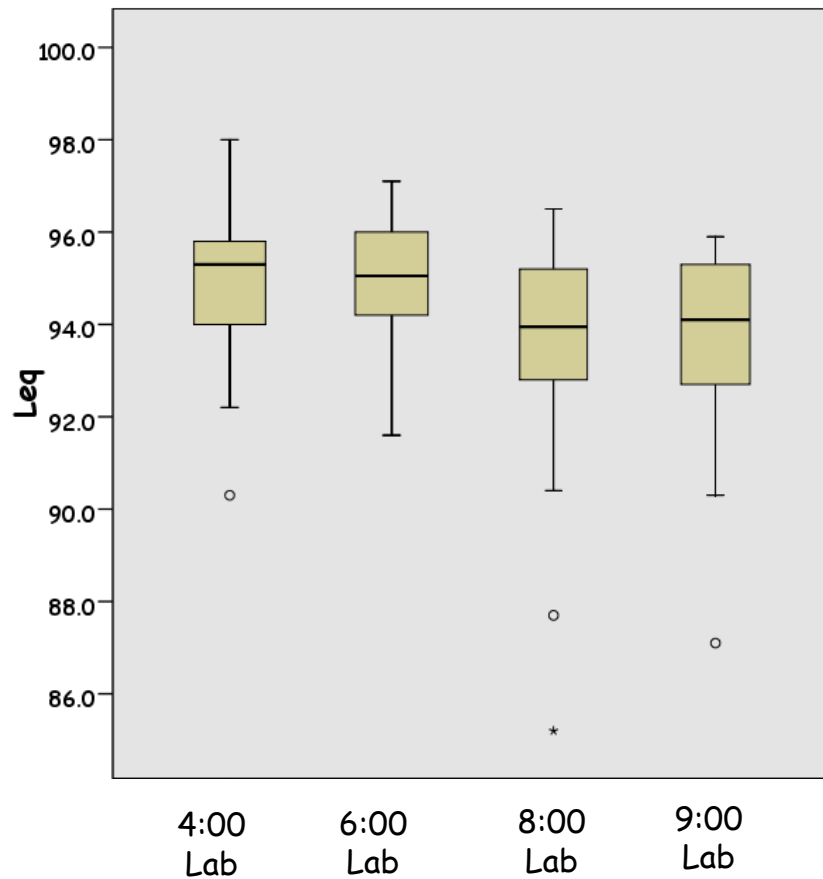
Ensembles in Kenton Hall



These large jazz (big) bands represent a common ensemble type for most college programs. Groups have traditional big band balanced instrumentation with total membership of 19. The distribution is as follows: Saxes (5), Trombones (5), Trumpets (5), Piano (1) Bass (1), Drum-set (1), Guitar (1).

Classes are scheduled for 50 minutes.

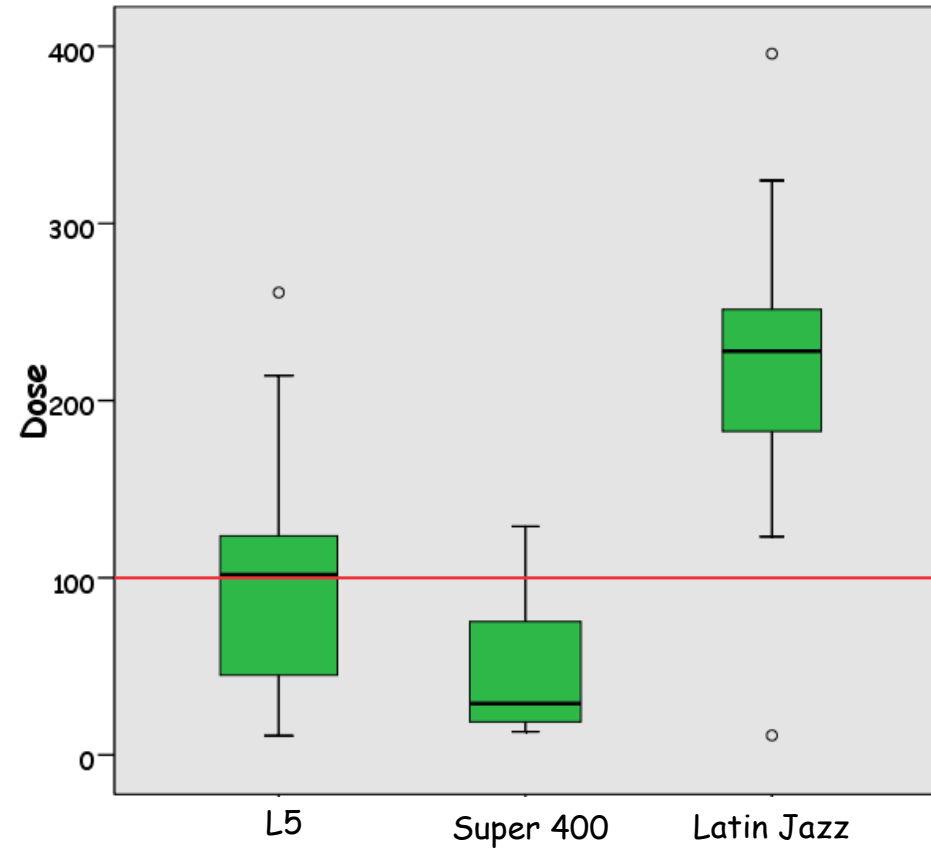
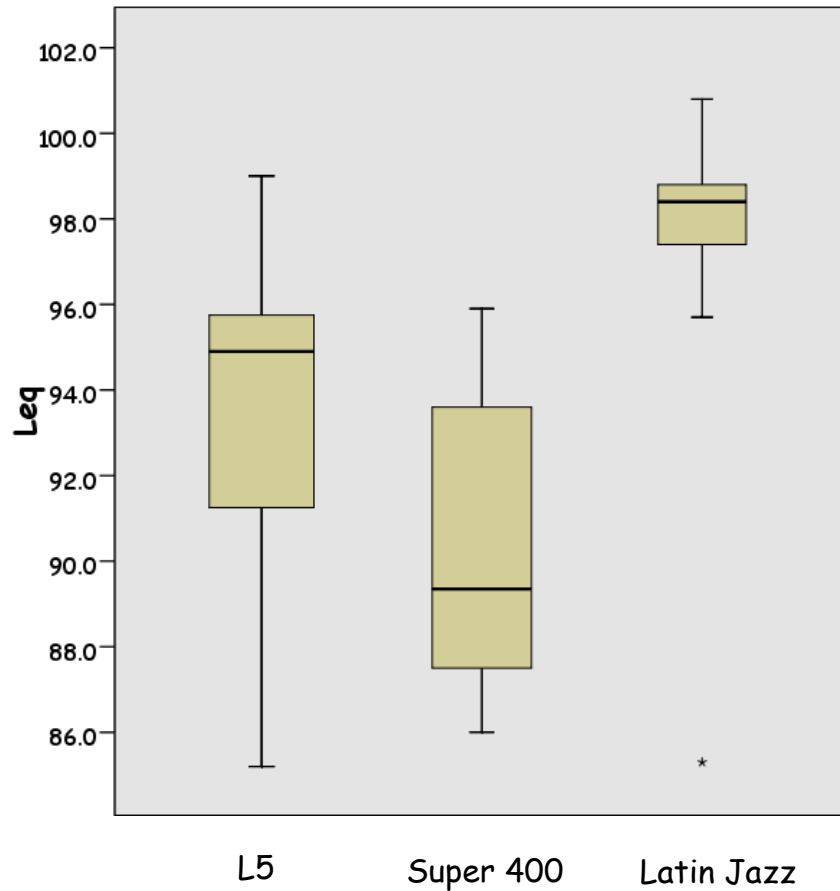
Ensembles in Lab East



These large jazz (big) bands represent a common ensemble type for most college programs. Groups have traditional big band balanced instrumentation with total membership of 19. The distribution is as follows: Saxes (5), Trombones (5), Trumpets (5), Piano (1) Bass (1), Drum-set (1), Guitar (1).

Classes are scheduled for 50 minutes.

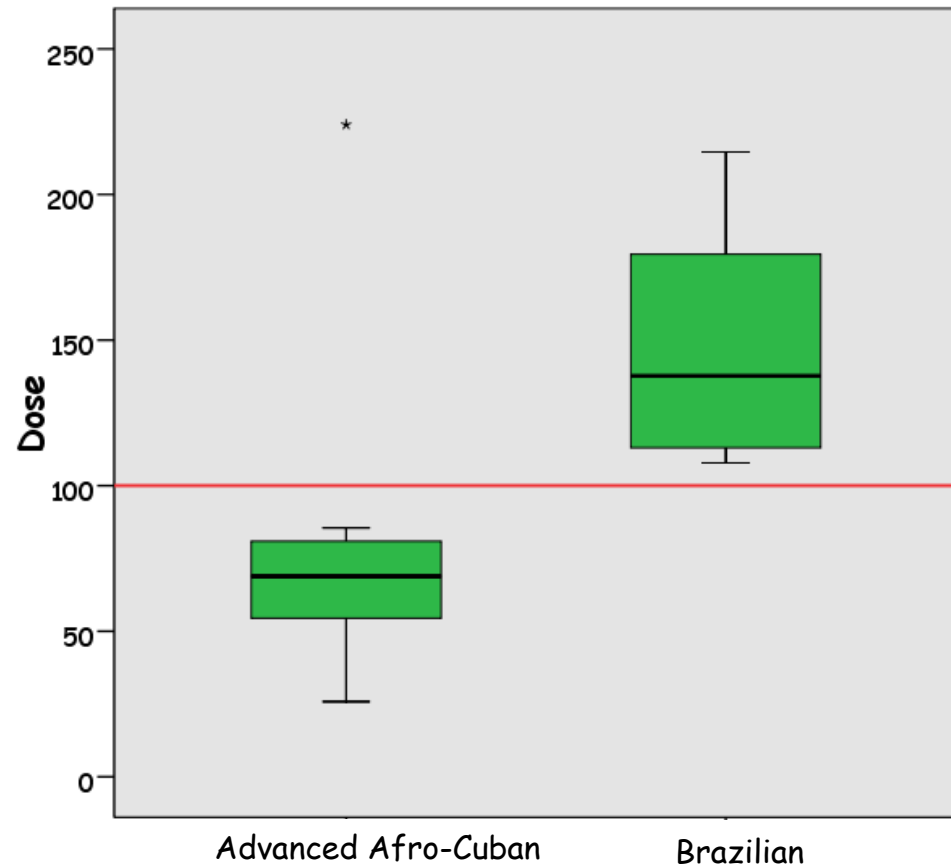
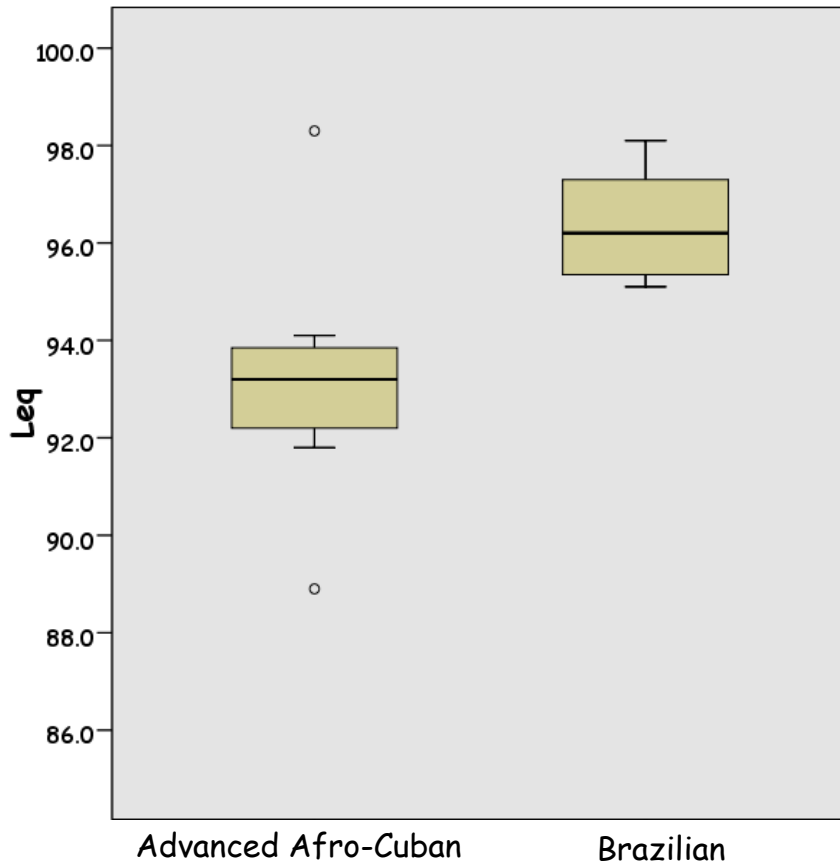
Ensembles in Room 262



L5 and Supper 400 are guitar ensembles comprising 5 guitars, drum-set and electric bass. The Latin Jazz ensemble includes 15 members featuring Saxes (3), Trombones (2), Trumpets (3), (1) Piano (1) Bass (1), Vibraphone (1), Guitar (1), Conga (1), Timbales (1), Bongo (1).

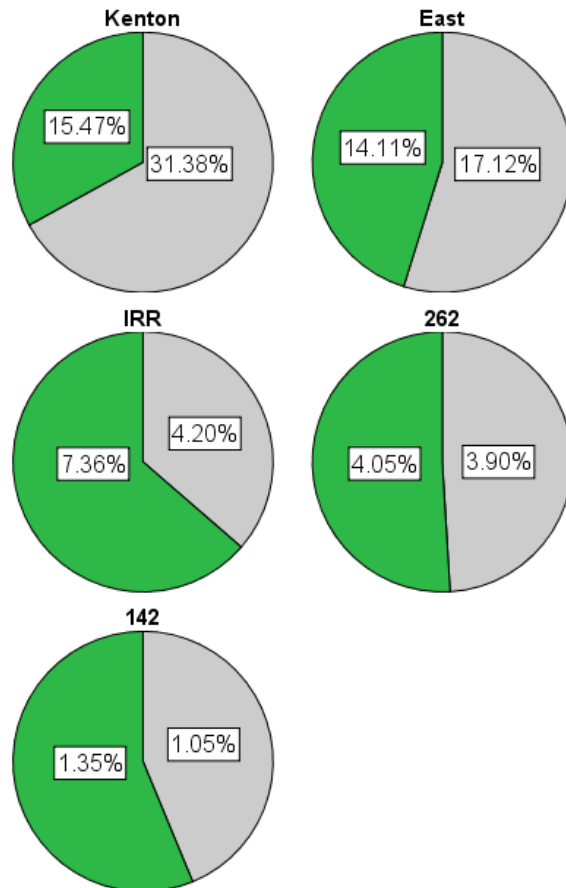
Classes are scheduled for 50 minutes.

Ensembles in Room 142



The Afro-Cuban and Brazilian ensembles are purely percussion ensembles. The Afro-Cuban group comprises 13 total musicians playing Congas (4), Cata (1), Clave (1), Shakers (3), Cajon (1), Batas (3). The Brazilian ensemble comprises 6 musicians playing: Surdo (2), Tamborims (2), Shaker (1), Snare Drum (1).

Percentage over 100% by Room



Limit
under 100% dose
Over 100% Dose

Numbers represent
percent of total
number of instructional
activities (N=666)

Percentage over 100% by Ensemble



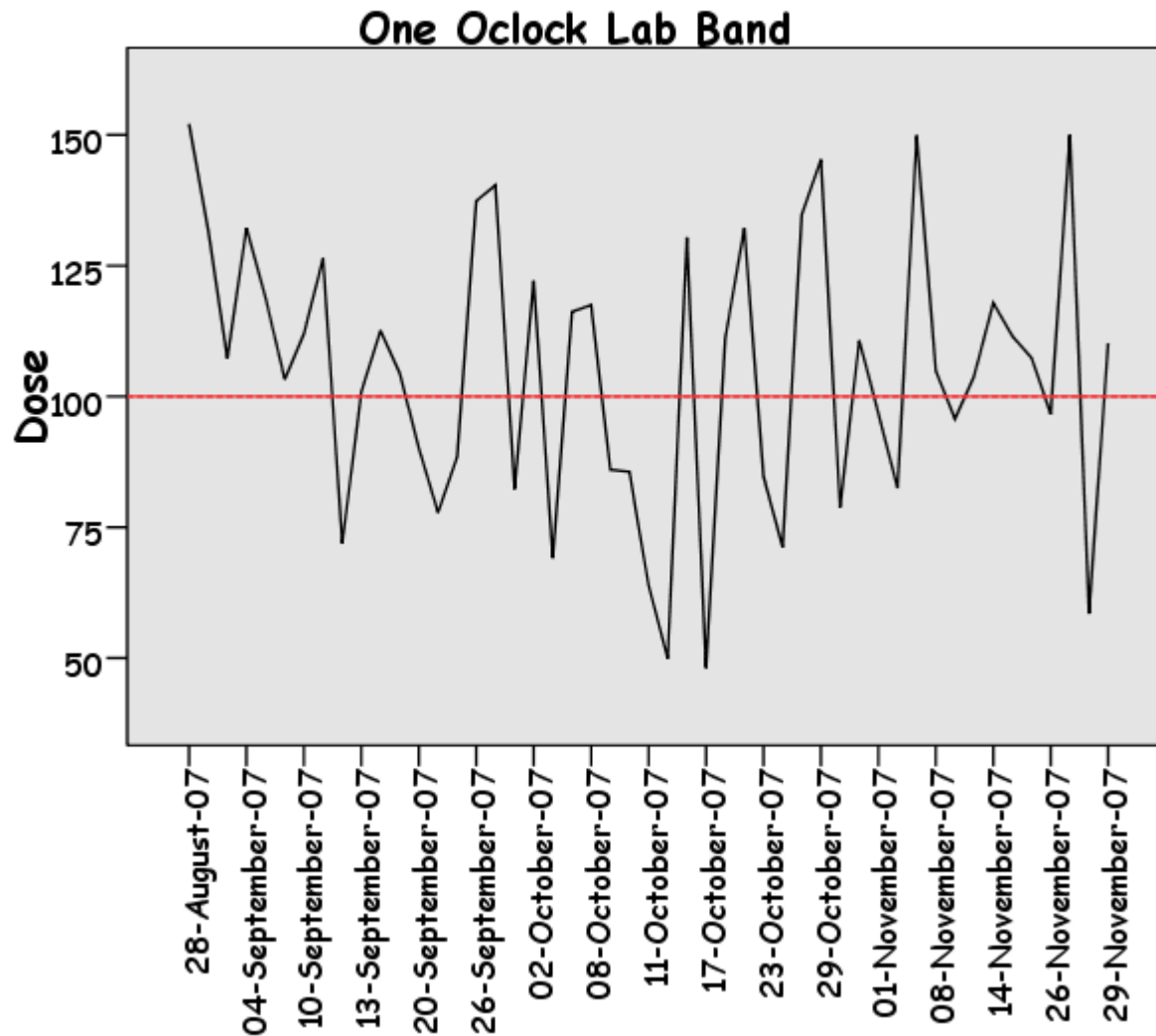
- **Primary Question**

- Do intensity levels produced during routine ensemble-based instructional activities exceed allowable limits set by National Institutes of Occupational Safety and Health?

- **Answer**

- YES! Dosimeter measurements show that routine ensemble-based instructional activities do exceed allowable limits. These limits are for the entire day. For most music majors, participation in an ensemble represents a fraction of total exposure per day. Exposures are cumulative.

- Data show large degrees of both inter and intra ensemble variability of intensity levels and suggests a multi-factorial set of influences.



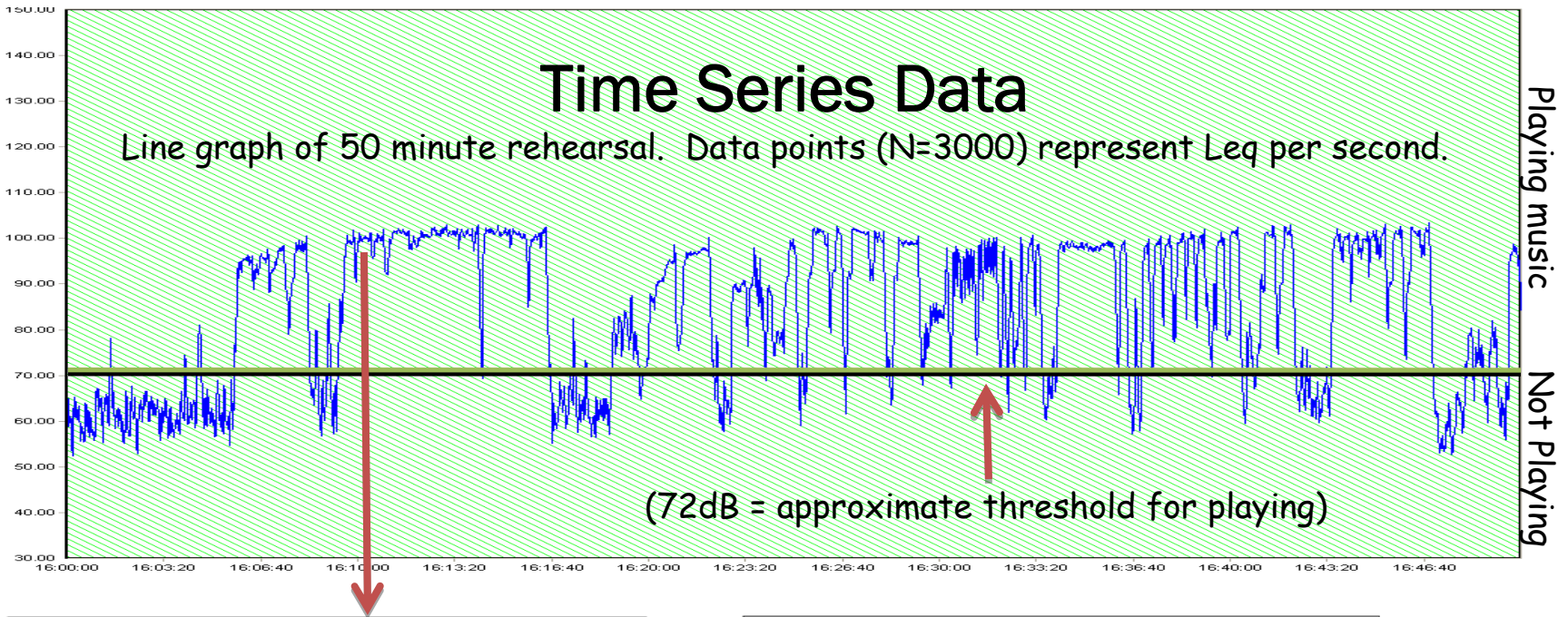
Problems with dosimeter-based assessment.

- Dosimeter-based sound intensity characterizations and risk indices fall short in providing the necessary detail for adequately understanding a musical event.
- Interpretation and intervention efforts focused on reducing risk are often misguided and ineffective.
- In fact, most are unfounded, costly, and in some cases introducing other problems.

Time Series Data

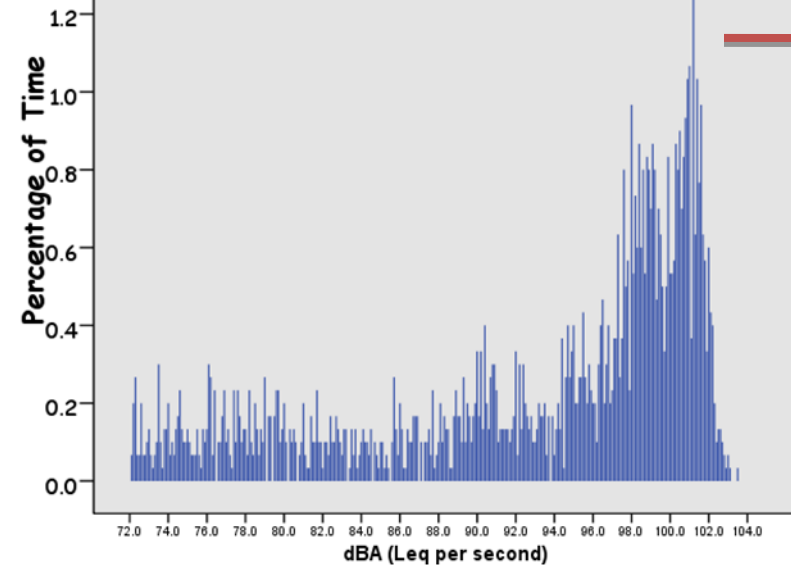
Line graph of 50 minute rehearsal. Data points (N=3000) represent Leq per second.

dB

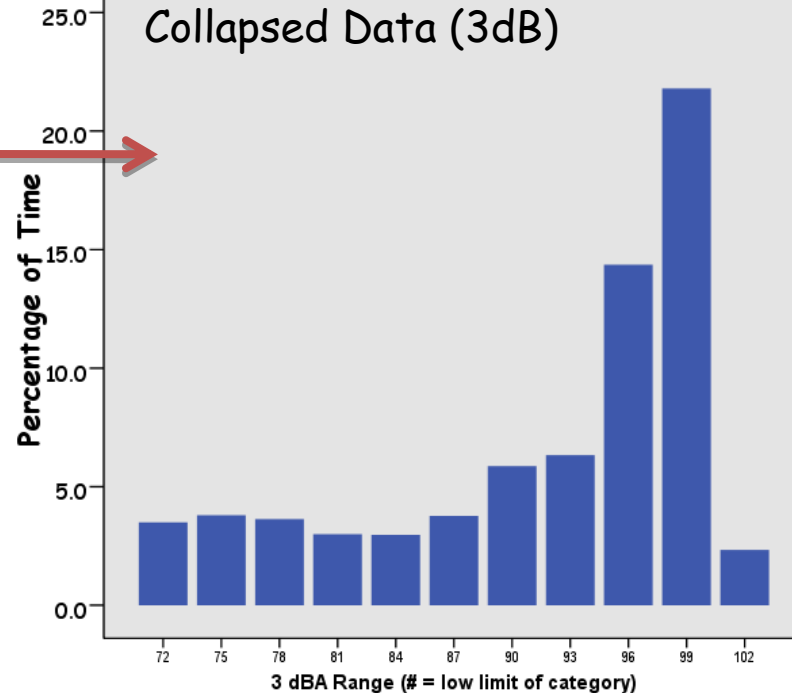


Histogram

(62% is above 72dB for this event)



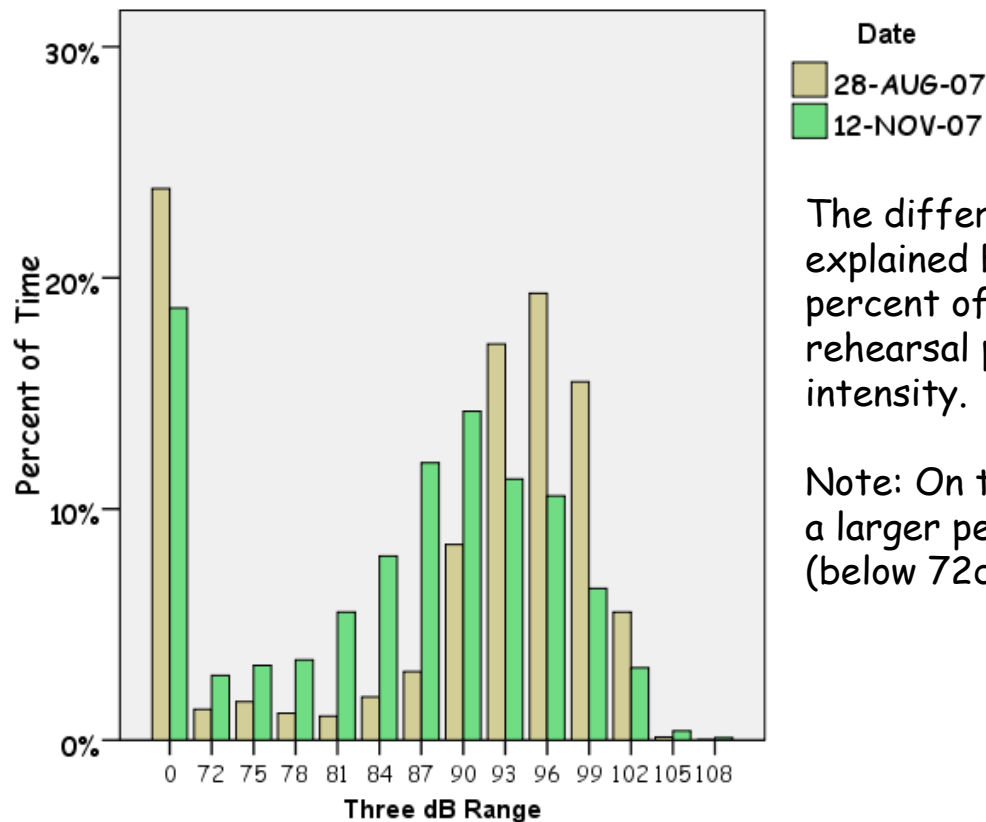
Collapsed Data (3dB)



Example of highest Leq not resulting in highest dose

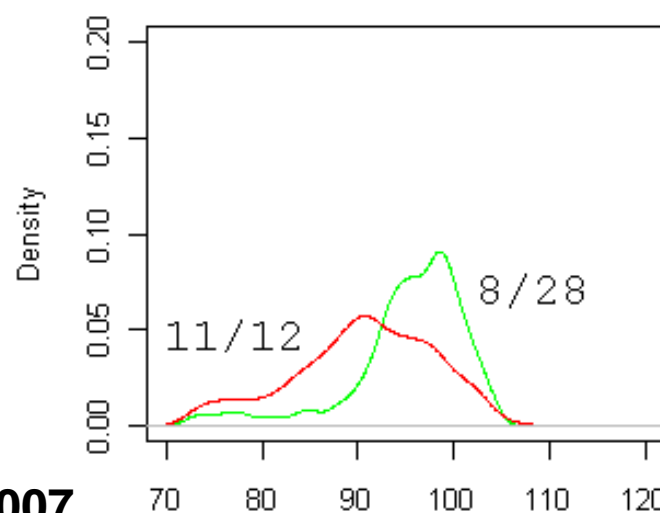
On November 12th, the 1 O'clock Lab Band reached 110.7 dB representing its maximum Leq/sec for the entire semester. The dose on this day was 95.7%.

Maximum Dose for entire semester was 152% on August 28th



The differences between these two days can be explained by observing the differences in the percent of time spent during the 50 minute rehearsal periods across various levels of intensity.

Note: On the day with the higher dose (Aug. 28), a larger percent of time was spent not playing (below 72dB).

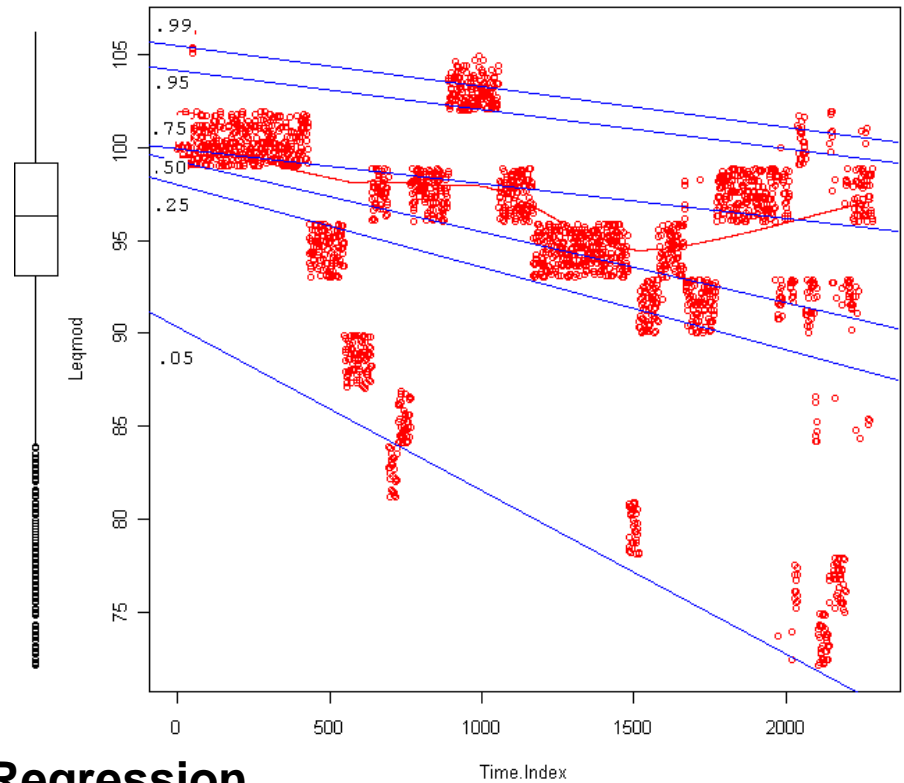
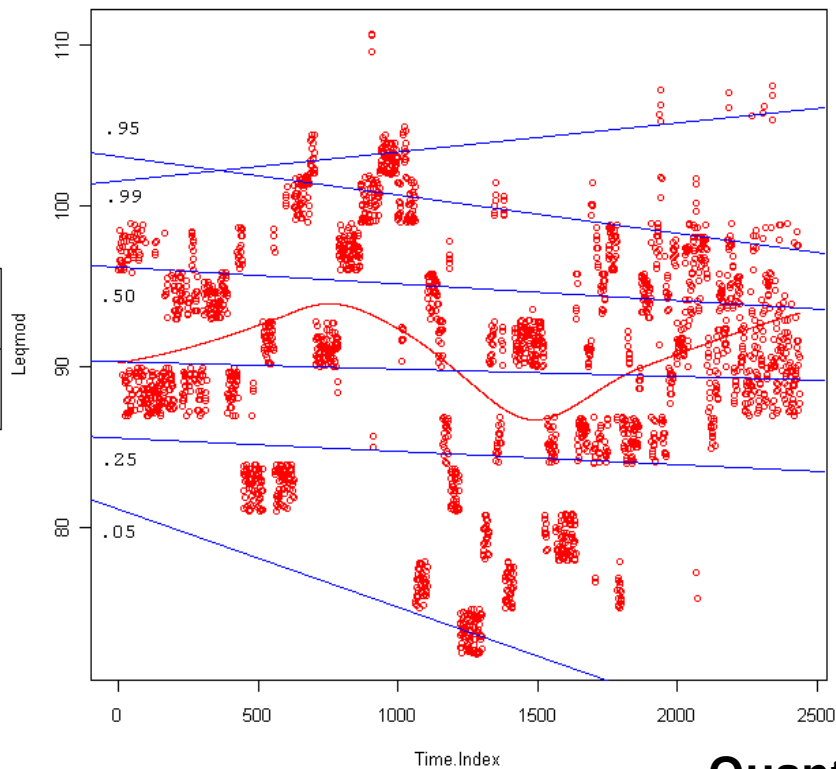


1 O'clock Band: 11/12/2007

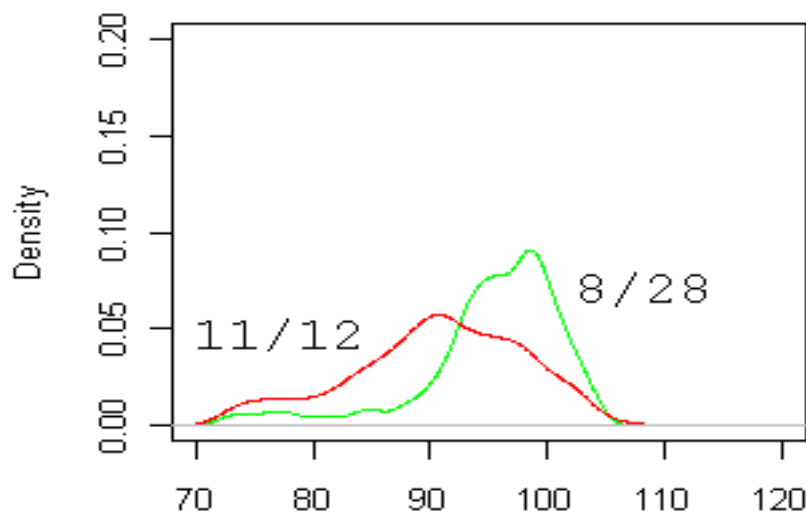
1 O'clock Band: Leqmod - 11/12/2007 - Gini=.046; Modified Dose=95.7%;
CV=12.20

1 O'clock Band: 8/28/2007

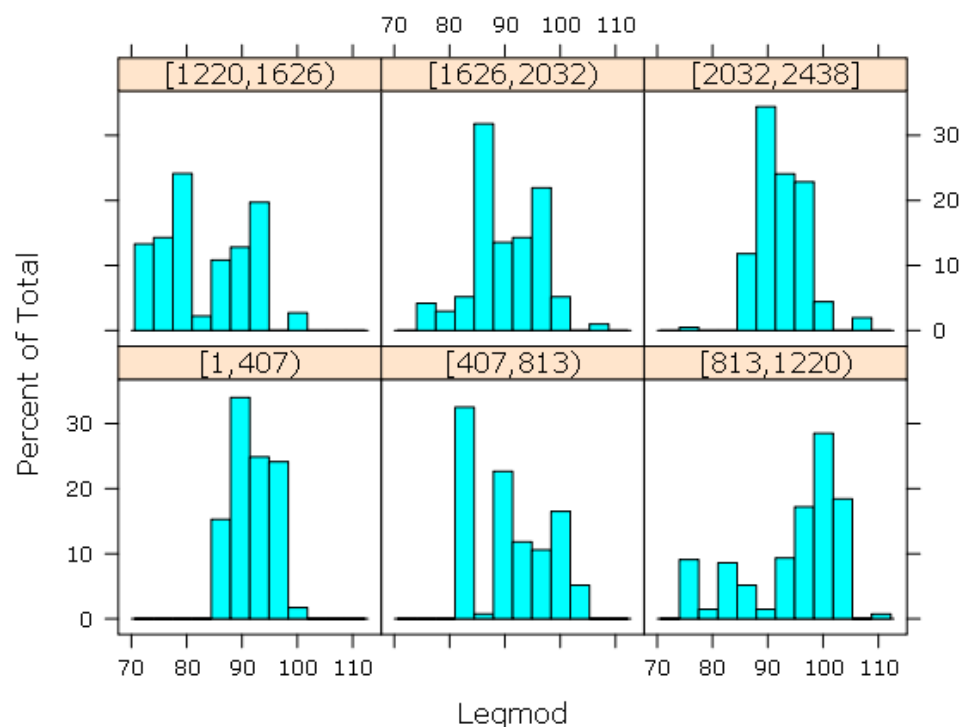
1 O'clock Band: Leqmod - 8/28/2007 - Gini=.034; Modified Dose=152%;
CV=15.16



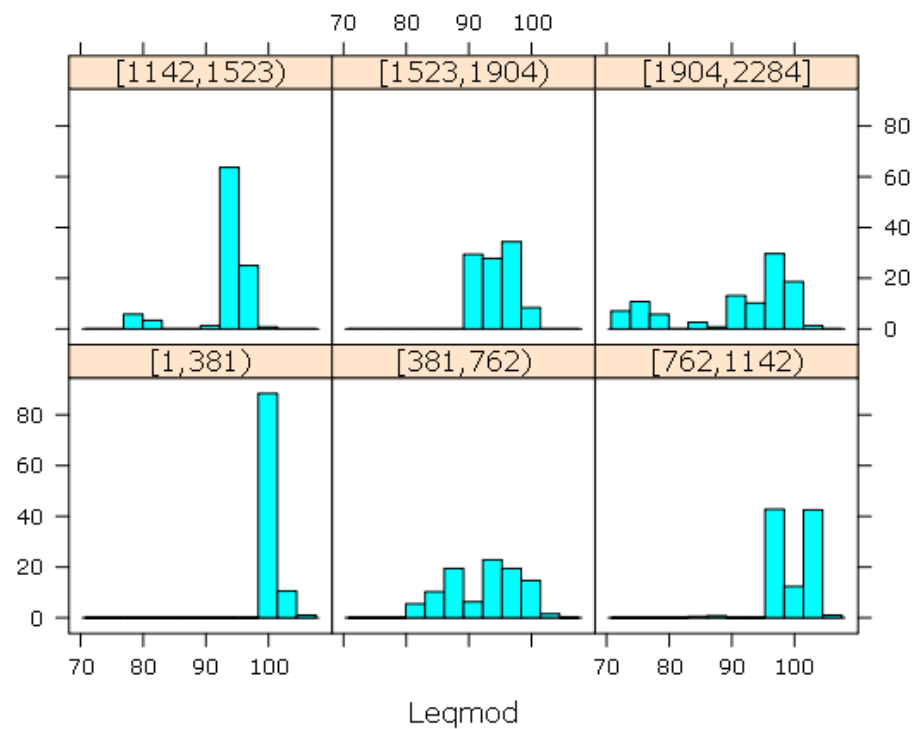
Quantile Regression



1 O'clock Band: 11/12/2007
Distribution of Leqmod by Time.Index

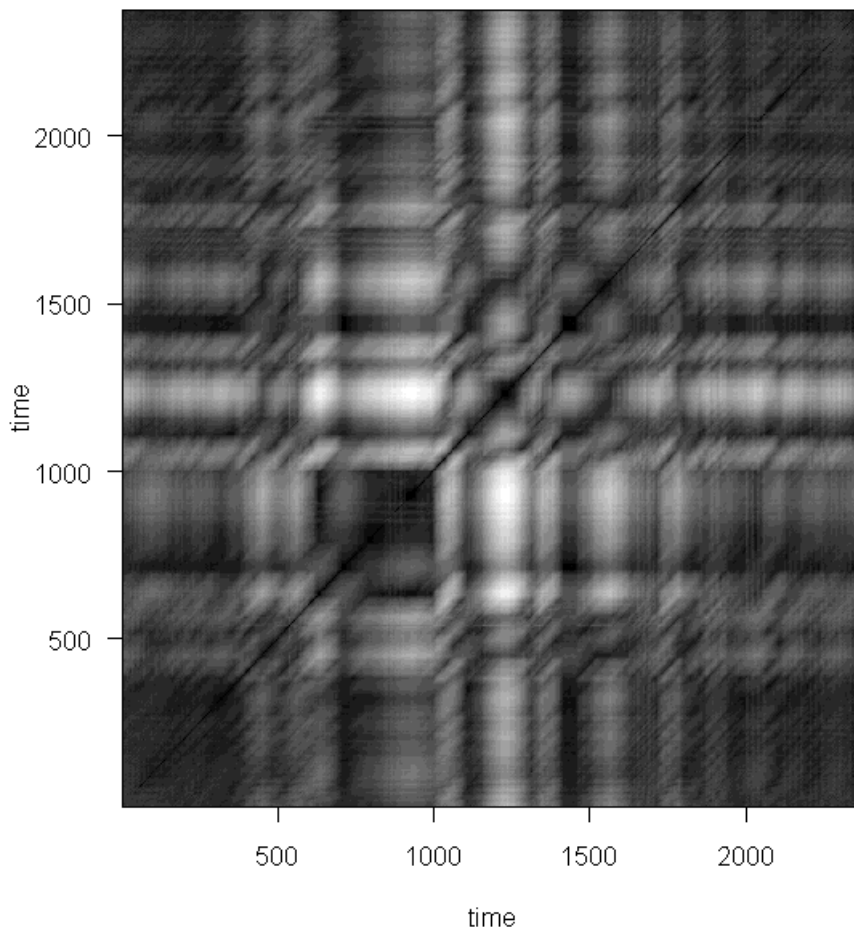


1 O'clock Band: 8/28/2007
Distribution of Leqmod by Time.Index



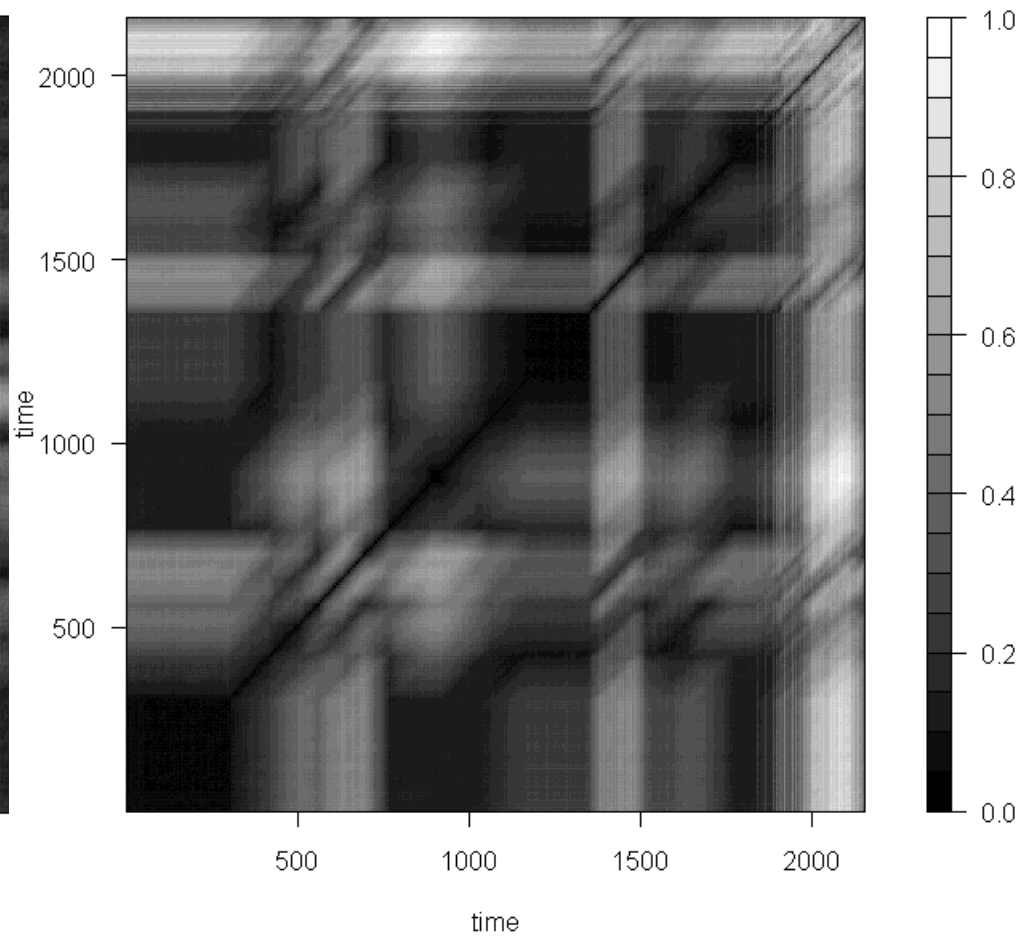
1 O'clock Band: Leqmod - 11/12/2007
Gini =.046; Modified Dose=95.7%; CV=12.20

Recurrence plot



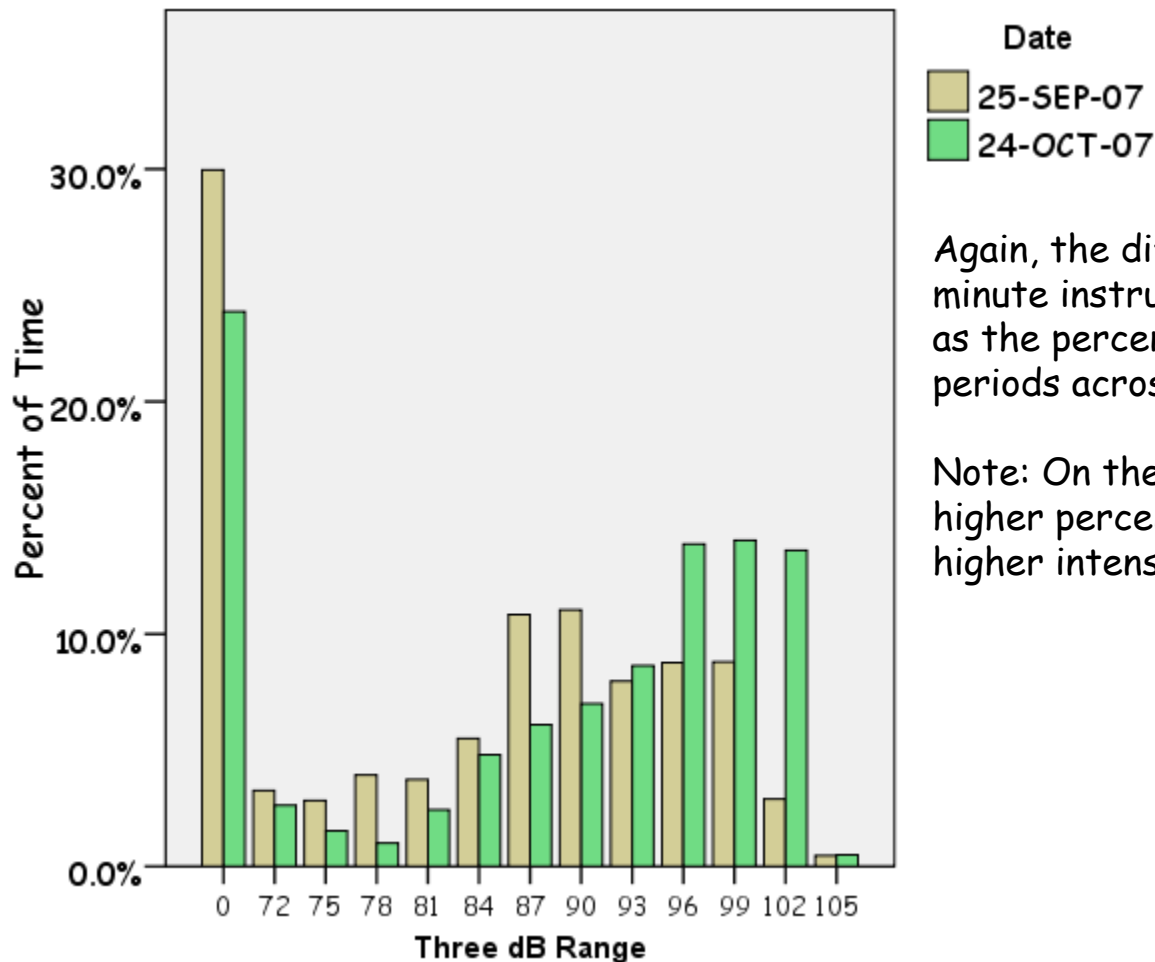
1 O'clock Band: Leqmod - 8/28/2007
Gini =.034; Modified Dose=152.1%; CV=15.16

Recurrence plot



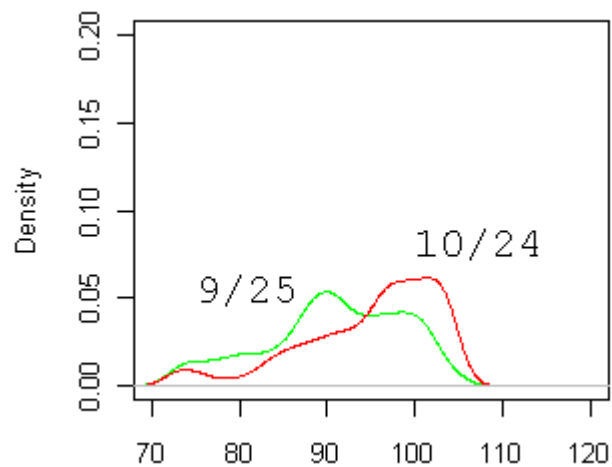
Equal max Leq/sec with different doses

Representing the maximum Leq/sec for the entire semester, the 5 O'clock Lab Band reached 106.3dB on both September 25th and on October 24. However, the doses associated with the two educational activities were 90.7% and 195% respectively.

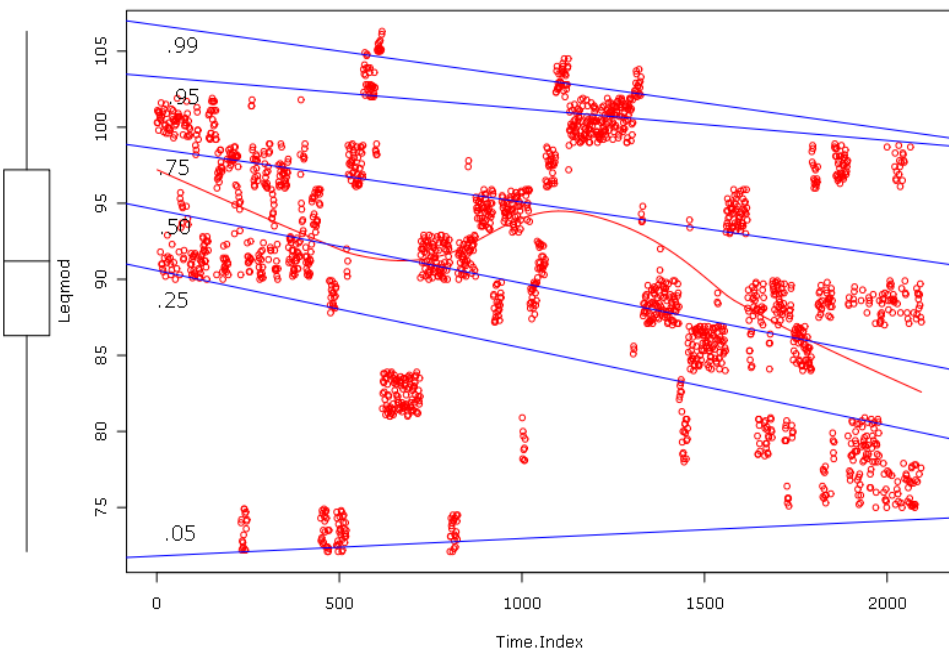


Again, the differences between these two 50 minute instructional activities can be observed as the percent of time spent during rehearsal periods across various levels of intensity.

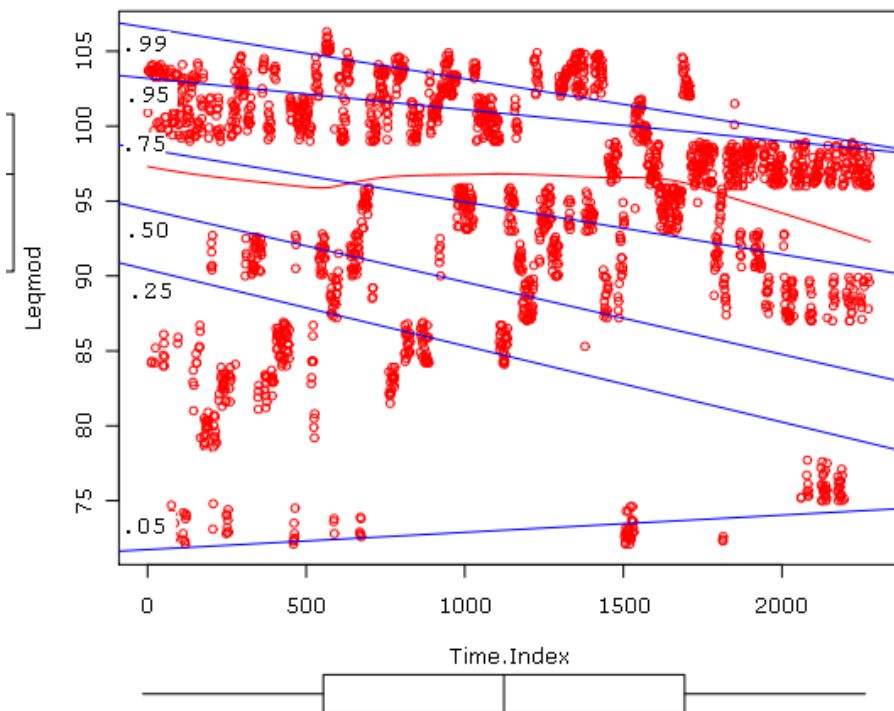
Note: On the day with the higher dose (Oct 24), higher percentages of time were spent at higher intensity levels.

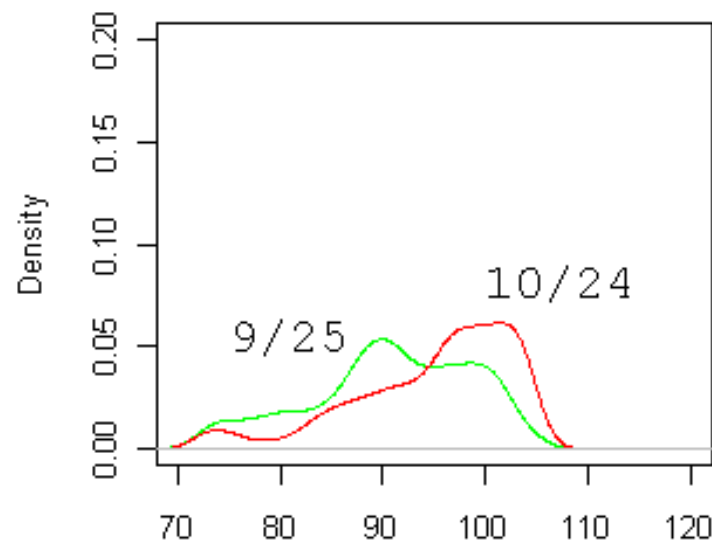


5 O'clock Band: Leqmod - 9/25/2007 - Gini =.011; Modified Dose=90%; CV=11.46



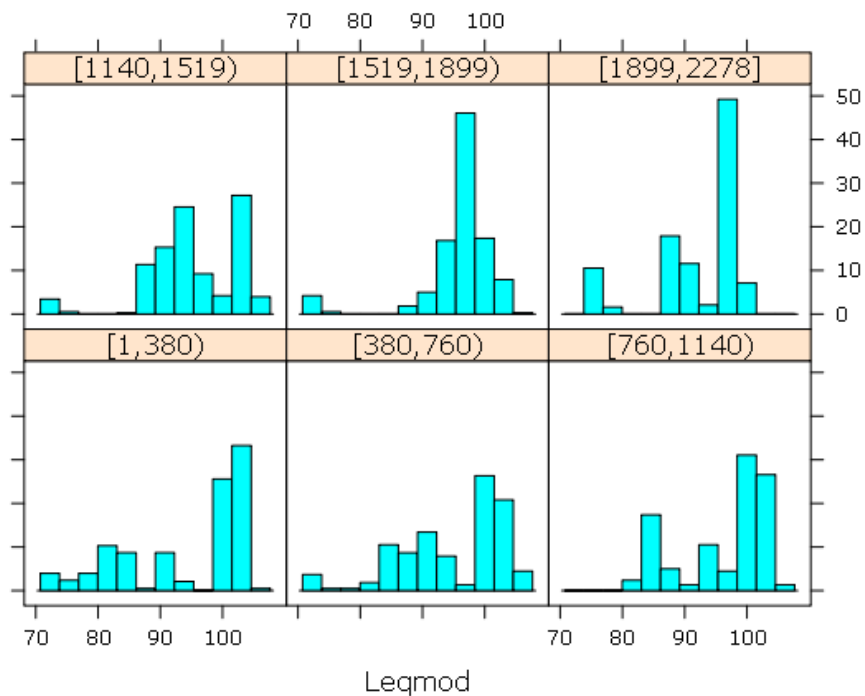
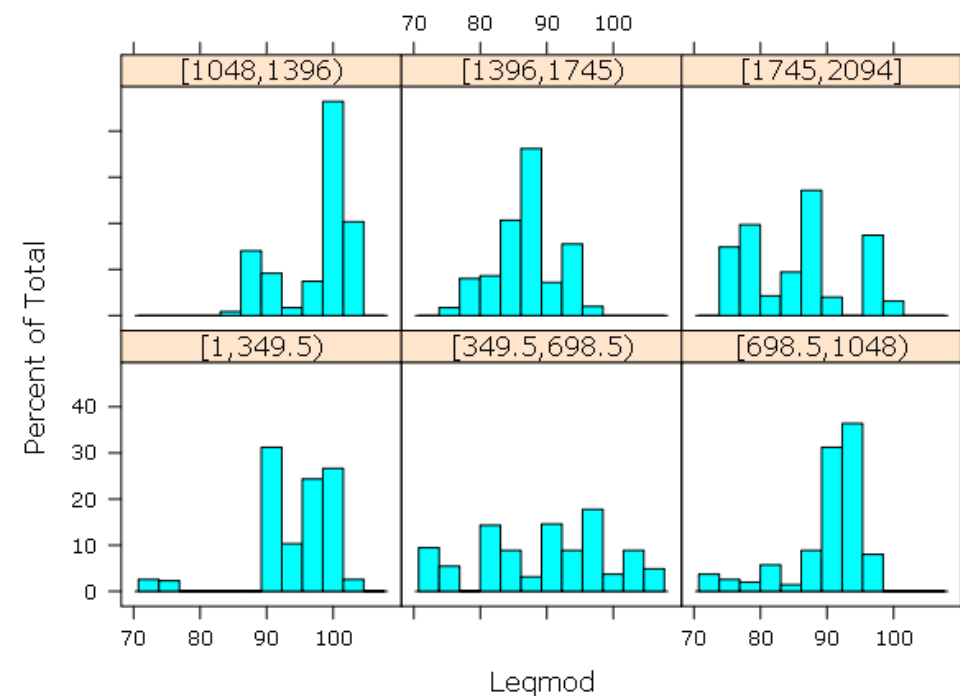
O'clock Band: Leqmod - 10/24/2007 - Gini=.010; Modified Dose=195; CV=12.10





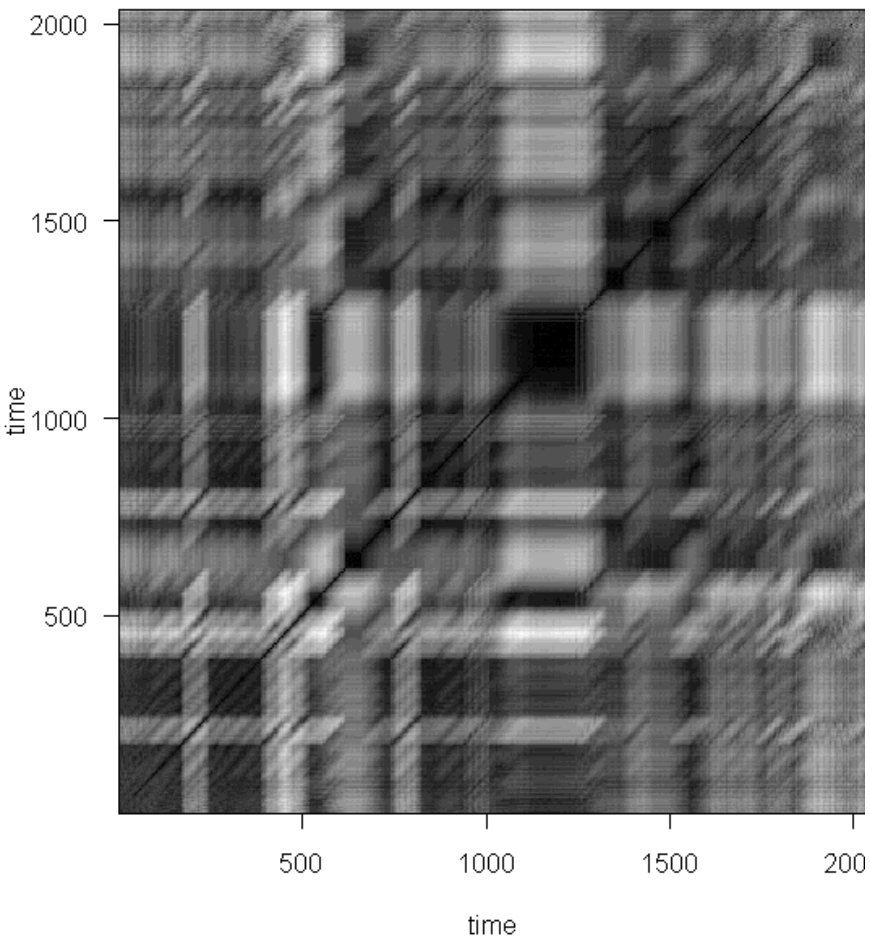
Distribution of Leqmod by Time.Index

Distribution of Leqmod by Time.Index



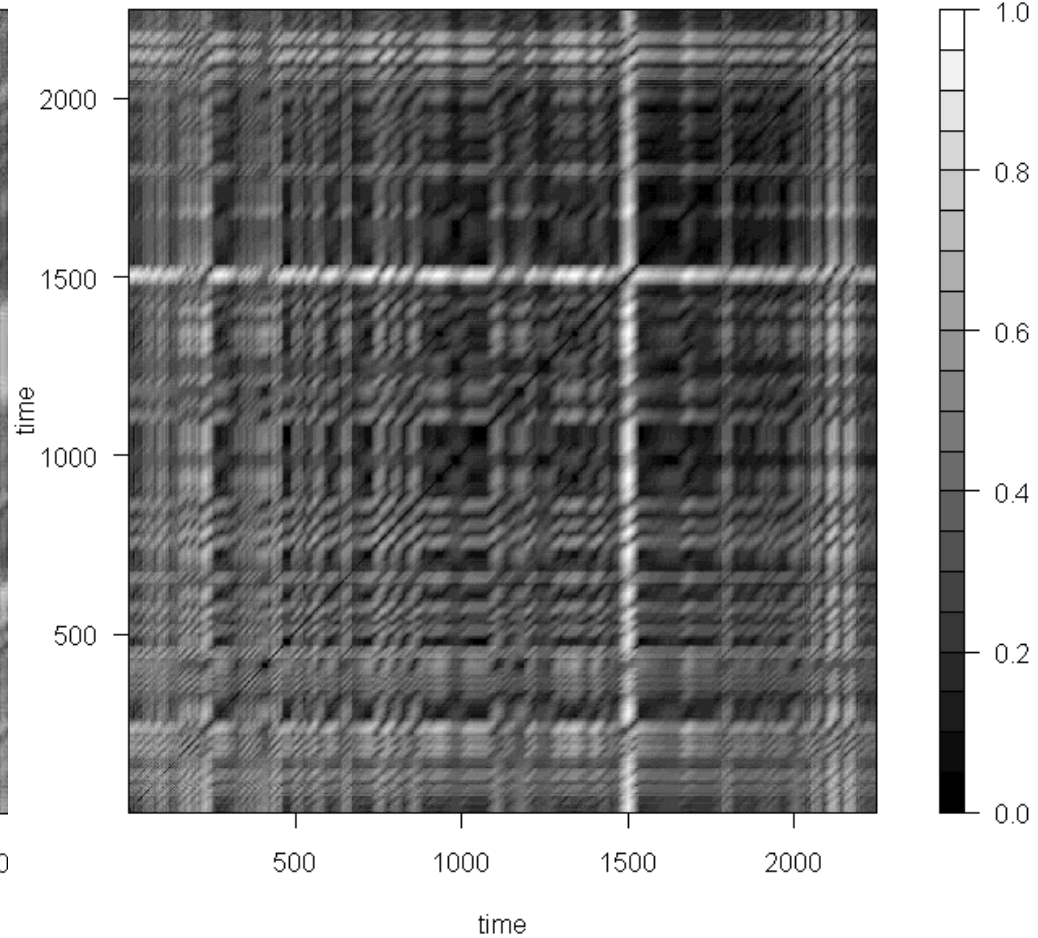
5 O'clock Band: Legmod - 9/25/2007
Gini =.011; Modified Dose=90%; CV=11.46

Recurrence plot



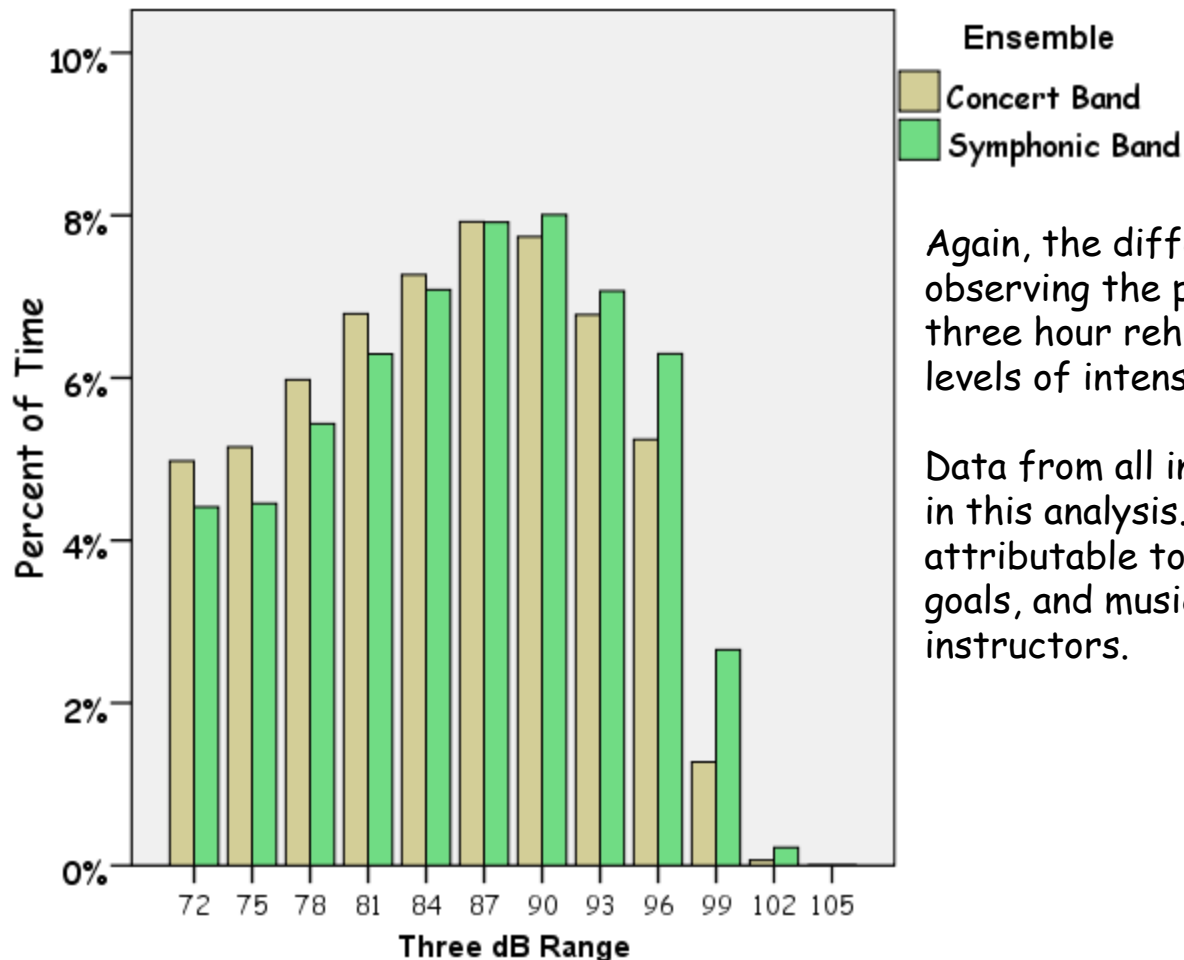
5 O'clock Band: Legmod - 10/24/2007
Gini =.010; Modified Dose=195%; CV=12.10

Recurrence plot



Tendencies

Both the Concert band and Symphonic band spend nearly identical amounts of time (40%) below 72dB. The average dose for these three hour instructional activities for the Concert band (93.6%) is lower compared to Symphonic band (121.0%).



Again, the differences can be explained by observing the percent of time spent during three hour rehearsal periods across various levels of intensity.

Data from all instructional events are included in this analysis. Differences may be attributable to selected literature, educational goals, and musical expectations of the ensemble instructors.

More questions

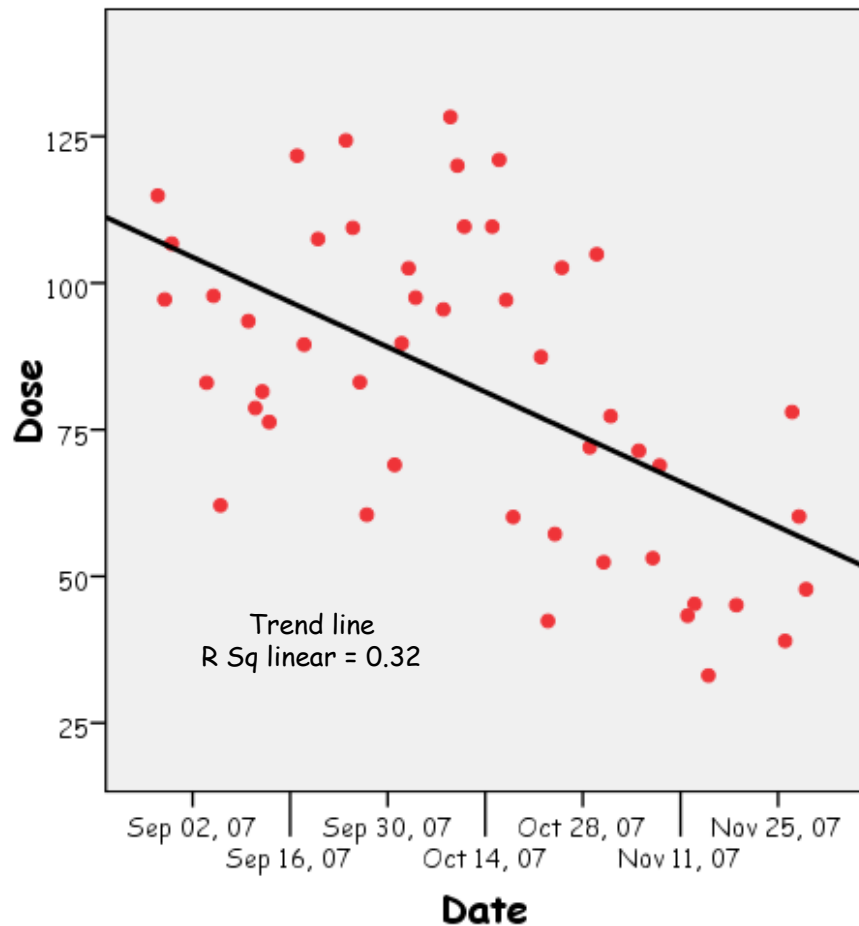
What are the relationships between “distribution of time spent at various intensity levels” and the “development of performance skills”?

What are the relationships between musical dynamics and risk levels?

Can schools of music prepare future ensemble directors to instruct effectively with lower risk?

Performance Practices and Risk Levels

Representing dose levels over one semester, the scatter-plot and fit line for the 2 O'clock Lab Band shows an important trend of decreasing dose over time. It is my personal belief that this data reflects one educational goal to play music with increased dynamics by practicing, and therefore spending more time, playing at soft and medium intensity levels.



Professor Riggs and the 2 O'Clock Lab Band